WHAT IS CLAIMED IS:

1   1.   A method for performing virtual examination of an object comprising:

2   performing at least one scan of an object with the object distended by the

3   presence of a contrast agent;

4   performing at least one scan of the object with the object relieved of the

5   contrast agent;

6   converting the scans to corresponding volume datasets comprising a

7   plurality of voxels;

8   performing image segmentation to classify the voxels of each scan into a

9   plurality of categories;

10   registering the volume datasets of each scan to a common coordinate

11   system;

12   displaying at least two of the volume datasets in a substantially

13   simultaneous manner; and

14   performing virtual navigation operations in one of the volume datasets and

15   having the corresponding navigation operations take place in at least one other volume

16   dataset.

1   2.   The method for performing virtual examination according to claim 1, wherein the

2   at least one scan of the distended object includes a transverse scan and a coronal scan of

3   the object.

1   3.   The method for performing virtual examination according to claim 2, wherein the

2   at least one scan of the relieved object includes a transverse scan and a coronal scan of the

3   object.

1   4.   The method for performing virtual examination according to claim 3, wherein the

2   object is a bladder.

1   5.   The method of performing virtual examination according to claim 4, wherein the

2   scans are computed tomography scans.

1   6.   The method of performing virtual examination according to claim 4, wherein the

2   scans are ultrasound imaging scans.

1   7.   The method of performing virtual examination according to claim 4, wherein the

2   scans are magnetic resonance imaging scans.

1   8   The method of performing virtual examination according to claim 7, wherein the

2   contrast agent is urine.

1   9.   The method for performing virtual examination according to claim 1, wherein the

2   at least one scan of the relieved object includes a transverse scan and a coronal scan of the

3   object.

1   10.   The method for performing virtual examination according to claim 1, wherein the

2   object is a bladder.

1   11.   The method of performing virtual examination according to claim 10, wherein the

2   scans are computed tomography scans.

1   12.   The method of performing virtual examination according to claim 10, wherein the

2   scans are ultrasound imaging scans.

1   13.   The method of performing virtual examination according to claim 10, wherein the

2   scans are magnetic resonance imaging scans

1   14.   The method of performing virtual examination according to claim 13, wherein the

2   contrast agent is urine.

1   15.   The method of performing virtual examination according to claim 1, further

2   comprising evaluating the at least one scan with the object distended and the at least one

3   scan with the object relieved to identify regions where contrast is more visible in one of

4   said scans and evaluating the scan with more contrast in a region of interest to determine

5   physiological characteristics of the object.

1　16.　The method of performing virtual examination according to claim 15, wherein said

2　step of image segmentation includes classifying voxels based on local intensity vectors of

3　the voxels.

1　17.　The method of performing virtual examination according to claim 16, wherein the

2　step of image segmentation further includes using a region growing algorithm to identify

3　regions of the object based on the classified voxels.

1　18.　The method of performing virtual examination according to claim 1, further

2　comprising partitioning the volume image datasets into a plurality of regions related to the

3　coordinate system.

1　19.　The method of performing virtual examination according to claim 18, wherein the

2　plurality of regions include eight regions defined in a three dimensional coordinate system.

1　20.　A method for performing virtual examination of an object comprising:

2　　　　　　performing an imaging scan of the object to acquire image scan data;

3　　　　　　converting the acquired image scan data to a plurality of voxels;

4　　　　　　interpolating between the voxels to generate an expanded dataset;

5　　　　　　performing image segmentation to classify the voxels into a plurality of

6　categories;

7　　　　　　extracting a volume of the object interior from the expanded dataset;

8　　　　　　generating a reduced resolution dataset from the expanded dataset;

1   storing the expanded dataset in a tree data structure;

2   rendering images for the expanded dataset and reduced resolution dataset;

3   and

4   selecting at least one of the reduced resolution dataset or expanded dataset

5   renderings for display.

1   21.   The method for performing virtual examination of an object of claim 20, wherein

2   the selecting step comprises:

3   selecting the reduced resolution dataset during image interaction; and

4   selecting the expanded dataset rendering if no image interaction has

5   occurred in a predetermined time period.

1   22.   The method for performing virtual examination of an object of claim 20, wherein

2   the imaging scan is a computed tomography scan.

1   23.   The method for performing virtual examination of an object of claim 20, wherein

2   the imaging scan is a magnetic resonance imaging scan.

1   24.   The method for performing virtual examination of an object of claim 20, wherein

2   the imaging scan is an ultrasound imaging scan.

1   25.   The method for performing virtual examination of an object of claim 20, wherein

2   the object is the larynx.

1   26.   The method for performing virtual examination of an object of claim 20, wherein

2   the tree structure is a binary space partition tree structure.

1   27.   A method of performing virtual angiography comprising:

2   acquiring imaging scan data including at least a portion of the aorta;

3   converting the imaging scan data to a volume representation including a

4   plurality of voxels;

5   segmenting the volume representation to classify the voxels into one of a

6   plurality of categories;

7   analyzing the segmented volume representation to identify voxels

8   indicative of at least a portion of an aneurysm in the aortic wall; and

9   generating at least one closing surface around the voxels indicative of at

10   least a portion of an aneurysm to estimate the contour of the aneurysm.

1   28.   The method of performing virtual angiography of claim 27, wherein the imaging

2   scan is a computed tomography scan.

1   29.   The method of performing virtual angiography of claim 27, wherein the imaging

2   scan is a magnetic resonance imaging scan.

1 30. The method of performing virtual angiography of claim 27, wherein the

2 segmenting operation classifies voxels in at least the categories of blood, tissue, and

3 calcium deposits.

1 31. The method of performing virtual angiography of claim 27, further comprising

2 estimating the volume of the aneurysm using the generated closing surfaces.

1 32. The method of performing virtual angiography of claim 27, further comprising

2 generating a navigation path through the aortic lumen.

3 33. The method of performing virtual angiography of claim 32, further comprising

4 estimating the length of the aneurysm based on the navigation path.

1 34. A method of performing virtual endoscopy of a blood vessel comprising:

2   acquiring imaging scan data including at least a portion of the vessel;

3   converting the imaging scan data to a volume representation including a

4 plurality of voxels;

5   segmenting the volume representation to classify the voxels into one of a

6 plurality of categories including the categories of blood, tissue, and calcium deposits; and

7   generating a navigation path through the vessel.

1 35. The method of performing virtual endoscopy of claim 34, wherein the vessel is a

2 carotid artery.

1 36. The method of performing virtual endoscopy of claim 34, further comprising the

2 step of determining the diameter of the carotid artery along the navigation path to identify

3 regions of narrowing.

1 37. The method of performing virtual angiography of claim 34, wherein the imaging

2 scan is a computed tomography scan.

1 38. The method of performing virtual angiography of claim 34, wherein the imaging

2 scan is a magnetic resonance imaging scan.

1 39. A method of determining the characteristics of a stent graft using virtual

2 angioscopy, comprising:

3   acquiring imaging scan data including at least a portion of the aorta;

4   converting the imaging scan data to a volume representation including a

5 plurality of voxels;

6   segmenting the volume representation to classify the voxels into one of a

7 plurality of categories;

8   analyzing the segmented volume representation to identify voxels

9 indicative of at least a portion of an aneurysm in the aortic wall;

10   generating at least one closing surface around the voxels indicative of at

11 least a portion of an aneurysm to estimate the contour of the aneurysm;

12   identifying the location of the endpoints of the aneurysm contour;

1   calculating the length between the endpoints of the aneurysm contour to

2   determine the length of the stent graft; and

3   calculating the diameter of the aortic lumen at the endpoints of the

4   aneurysm contour to determine the required outside diameters of the stent graft.

1   40.   The method of determining the characteristics of a stent graft of claim 39, further

2   comprising determining the angle of interface of the aneurysm and normal aortic lumen to

3   determine an angular direction of a corresponding end of the stent graft.

1   41.   The method of determining the characteristics of a stent graft of claim 39, further

2   comprising locating arterial branches proximate the aneurysm to determine a maximum

3   length of the stent graft.

1   42.   The method of determining the characteristics of a stent graft of claim 41, wherein

2   the arterial branches proximate the aneurysm include at least one of the renal and femoral

3   arterial branches.

1   43.   The method of determining the characteristics of a stent graft of claim 39, further

2   comprising conducting a virtual biopsy of the aortic region proximate the ends of the

3   aneurysm to determine the nature of the tissue at the anticipated graft interface locations.

1   44.   A method of defining a skeleton for a three dimensional image representation of a

2   hollow object formed with a plurality of voxels comprising:

3   identifying a root voxel within the hollow object;

4   generating a distance map for all voxels within the hollow object, the distance map

5 being formed using a 26-connected cubic plate of neighboring voxels having Euclidian

6 weighted distances;

7   identifying voxels having a local maxima in the distance map as endpoints of

8 branches in the hollow object; and

9   for each local maxima voxel, determining a shortest connected path to one of the

10 root voxel or a previously defined shortest path.

1   45.   The method of defining a skeleton for a three dimensional image representation of

2 claim 44 further comprising performing multi-resolution data reduction to the three

3 dimensional image representation to generate a reduced data set for the generating and

4 identifying operations.

1   46.   The method of defining a skeleton for a three dimensional image representation of

2 claim 44 further comprising centralizing the shortest paths within the respective branches

3 of the object.

1   47.   The method of defining a skeleton for a three dimensional image representation of

2 claim 44, wherein the object includes at least one blood vessel.

1   48.   The method of defining a skeleton for a three dimensional image representation of

2 claim 44, wherein the object includes the airways of a lung.

1   49.   The method of defining a skeleton for a three dimensional image representation of

2   claim 44, wherein the object includes the bladder.

1   50.   The method of defining a skeleton for a three dimensional image representation of

2   claim 44, wherein the object includes the spinal cord of a vertebrate animal.

1   51.   A method of performing computed assisted diagnosis of a region of interest,

2   comprising:

3   acquiring imaging scan data including at least a portion of the region of

4   interest;

1   converting the imaging scan data to a volume representation including a

2   plurality of voxels, at least a portion of the voxels representing a surface of the region of

3   interest; and

4   analyzing said portion of voxels representing a surface for at least one of a

5   geometric feature and a textural feature indicative of an abnormality.

1   52.   The method of performing computed assisted diagnosis according to claim 51,

2   wherein the textural feature is included in a probability density function characterizing a

3   correlation between two voxels of the portion of voxels.

1   53   The method of performing computed assisted diagnosis according to claim 52,

2   wherein the two voxels are adjacent voxels.

1   54.   The method of performing computer assisted diagnosis according to claim 52,

2   wherein intensities of said portion of voxels are used to generate an estimate of the

3   probability density function.

1   55.   The method of performing computer assisted diagnosis according to claim 54,

2   wherein a plurality of voxel intensities are used to generate a cumulating distribution

3   function of the region of interest and a local cumulating distribution function, and wherein

4   the local cumulating distribution function is compared against the context cumulating

5   distribution function to identify regions of abnormality.

1   56.   The method of performing computer assisted diagnosis according to claim 55,

2   wherein a distance is determined between said local cumulating distribution function and

3   said context cumulating distribution function, the distance providing a measure of

4   abnormality.

1   57.   The method of performing computer assisted diagnosis according to claim 56,

2   wherein the distance is used to assign intensity values to the voxels representing a surface

3   of the region of interest and wherein said method further comprises displaying said voxels

4   such that variations in intensity represent regions of abnormality.

1 58. The method of performing computer assisted diagnosis according to claim 57,

2 wherein the region of interest includes the colon and wherein the abnormality includes

3 polyps.

1 59. The method of performing computer assisted diagnosis according to claim 51,

2 wherein the region of interest includes the aorta and wherein the abnormality includes

3 abdominal aortic aneurysms.

1 60. The method of performing computer assisted diagnosis according to claim 51

2 wherein the surface is represented as a second differentiable surface where each surface

3 volume unit has an associate Gauss curvature and wherein said Gauss curvatures combine

4 to form said geometric features.

1 61. The method of performing computer assisted diagnosis according to claim 59

2 wherein a plurality of predetermined geometrical feature templates are defined and

3 wherein the geometric features of said surface are compared to said templates to determine

4 a geometric feature classification.